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# MEMOIRS

OF THE

## GEOLOGICAL SURVEY

OF

### THE UNITED KINGDOM.

Figures and Descriptions

ILLUSTRATIVE OF

### BRITISH ORGANIC REMAINS.

DECADE I.-VI

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF HER MAJESTY'S TREASURY.

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## N O T I C E.

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PALÆONTOLOGICAL researches forming so essential a part of geological investigations, such as those now in progress by the Geological Survey of the United Kingdom, the accompanying plates and descriptions of British Fossils have been prepared as part of the Geological Memoirs. They constitute a needful portion of the publications of the Geological Survey, and are taken from specimens in the public collections, or lent to the Survey by those anxious to advance this branch of the public service. Although numerous drawings had previously been made, and engravings from them considerably advanced, it was not thought expedient to commence their publication until the large collections of the Survey could be well examined, which a want of the needful space has, until the present time, considerably retarded. This impediment to progress is now being removed, and when the collections can be properly displayed in the New Museum of Practical Geology, in Jermyn Street, it is hoped that the public will have an opportunity of gradually obtaining, in a convenient manner and at small cost, a work illustrating some of the more important forms of animal and vegetable life there preserved, and which have been entombed during the lapse of geological time in the area occupied by the British islands.

The plan proposed to be followed in the work, of which the two Decades now published form a part, is as follows:—

To figure in elaborate detail, as completely as possible, a selection of fossils, illustrative of the genera and more remarkable species of all

classes of animals and plants the remains of which are contained in British rocks ; to select especially such as require an amount of illustration which, to be carried out by private enterprise, would require a large outlay of money, with little prospect of a return, and a long time to accomplish, but which, by means of the staff and appliances necessarily employed on the Geological Survey, can be effected at small cost, and with a rapidity demanded by the publication of the maps and memoirs of the Survey ; thus, it is hoped, affording an aid to those engaged in the sciences with which this work is connected, that they might not otherwise have possessed, and which may materially promote the progress of individual research.

H. T. DE LA BECHE,  
*Director-General.*

*Geological Survey Office,*  
*24th May, 1849.*

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## BRITISH FOSSILS.

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### DECADE THE FIRST.

THE first Decade of representations of British Fossils is devoted to a selection of Echinoderms, of the Orders *Asteriadae* and *Echinidae*.

With the exception of the *Crinoidea* and *Cystidea*, no special monographs have been devoted to the illustration of our fossil species of Echinodermata, notwithstanding their acknowledged importance in a geological point of view. The majority of species found in British strata are unfigured in British works; a very great number are not figured at all, and those of which we possess British figures are, for the most part, delineated either imperfectly or insufficiently for the demands of science in its present state. This is the more remarkable since, for the description and delineation of numerous species, ample materials exist in collections.

Of the following plates, one is devoted to figures of all the Silurian star-fishes as yet discovered in British strata. None of these have hitherto been represented in any work. Their names only, accompanied by short descriptive characters, have appeared in the "Synopsis of British Fossil Asteriadae," contained in the second part of the second volume of the "Memoirs of the Geological Survey of Great Britain." Some remarkable new forms of star-fishes from the Oolites, and all as yet discovered in the London clay, are figured in the second and third plates.

The fourth plate is devoted to a representation of the only fossil as yet discovered of the family *Euryales*, now for the first time described and figured, through the kind co-operation of the Rev. Professor Sedgwick.

In the six following plates a series of illustrations of the British fossil *Echinidæ* is commenced, of the majority of which, even the commonest and those most important for the identification of strata, no good representations are accessible to the student of English fossils. The importance of a knowledge of the members of this family to the explorers of oolitic and cretaceous strata cannot be too strongly insisted on, and their beauty and interest, in a purely Natural History point of view, render them admirable subjects for elaborate delineations.

When the collections accumulated during the course of the progress of the Geological Survey have been thoroughly examined and arranged, new light may be expected, bearing on the details of structure of the species now figured. Additions will consequently be made to the plates from time to time; and it is proposed to issue supplementary figures of the variations of form exhibited by the several species selected as subjects for these decades.

EDWARD FORBES.

*May*, 1849.

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# BRITISH FOSSILS.

## DECADE I. PLATE VI.

### ECHINUS GRANULOSUS.

[Genus ECHINUS. LINNÆUS. (Sub-kingdom Radiata. Class Echinodermata. Order Echinidæ. Family Cidarites.) Body more or less spherical; ambulacral and interambulacral segments developed, bearing on their plates tubercles of various sizes; anus central, not furnished with regular calcareous valves, surrounded by a circle of five ovarian and five ocular plates, all perforated; ambulacral avenues composed of pairs of pores ranged in series of three or more; spines of one order.]

SYNONYMS. *Echinus granulatus*, MUNSTER, in GOLDFUSS, Pet. Germ., p. 125, pl. 49, f. 5 a, b. *Echinus Bennetticæ*, KÖENIG, Icon. Sect., p. 35. *Echinus granulatus*, GRATELOUP, Mem. Ours. foss., p. 82. *Echinus granulatus*, DUJARDIN, in second edition of LAMARCK, An. sans Vert., vol. iii., p. 372. *Arbacia granulosa*, AGASSIZ, Cat. Syst., p. 12. MORRIS, Cat. Brit. Fos., p. 48. AGASSIZ and DESOR, Cat. Rais. des Echinides, Ann. des Sc. Nat., 3rd Ser., vol. vi., Zoologie, p. 356.

DIAGNOSIS. *E. assulis numerosis, centro-lateralibus angustissimis, dense tuberculatis; tuberculis primariis parvis æqualibus, regulariter in seriebus horizontalibus dispositis; poris ambulacralibus in seriebus triplicibus verticalibus et ut in ordine simplici dispositis, sed prope orem verè subobliquis.*

This pretty and plentiful little fossil urchin was first figured as British, though very imperfectly, by Mr. König, in his "Icones Sectiles," under the name of *Echinus Bennetticæ*, and as a German species, by Goldfuss, under the name of *Echinus granulatus*, given it by Munster. The figure and description in the "Petrefacta Germanica" are so complete, that we cannot hesitate to adopt the name by which this fossil is known to geologists and collectors.

In recently published catalogues it figures as a species of *Arbacia*, and in the "Catalogue Raisonné des Echinides" of Agassiz and Desor heads the second type of that genus—the section in which the tubercles are described as uniform all over the surface of the shell. *Echinus monilis*, a species bearing considerable resemblance to that before us, and well known both in the fossil and recent state, having been found in French and British upper tertiaries, and by myself alive in the Mediterranean, is placed by the authors quoted at the head of their first type of the genus. *Arbacia* is a group of *Echinidæ*, founded by Mr. J. E. Gray in 1835 (Zool. Proc., part 3, p. 58), for a section of the genus

*Echinus*, in which, according to the founder, the body is depressed, the ambulacral areas very narrow, the ambulacra narrow, straight, and containing pairs of pores ranged in a single row, the ovarian and inter-ovarian plates middle-sized, and the anus covered by four valves. The types of this genus, as cited by its founder, are the *Echinus pustulosus* of Lamarck and the *E. punctulatus* of the same author. The genus is a good one, though its characters were partially misunderstood by its founder, for the ambulacral pores are not uniserial. It presents a very peculiar and undescribed structure of the ocular plates. The characters of *Arbacia*, as given by Agassiz, are, however, altogether different from those just cited, for he confines it to "small subspherical urchins, having the test covered by numerous little smooth-based imperforate tubercles, ranged in numerous rows on the interambulacral areae, and sometimes also on the ambulacral ones. Pores ranged in a simple series. Mouth circular, without deep notches. Genital apparatus narrow and ring-shaped." All the species enumerated in his synopsis are cretaceous or tertiary fossils. The *Arbaciæ* of Gray are transferred to *Echinocidaris* of Desmoulins, a genus synonymous with *Arbacia*, in the sense of its founder's definition. In that sense the several fossils enumerated under *Arbacia*, in the "Catalogue Raisonné des Echinides," cannot be so called,\* for neither *Echinus monilis* nor *Echinus granulosus* partake of its characters. They are, in fact, true *Echini*, as I have elsewhere shown, when describing the living *E. monilis*, and am prepared to prove, with respect to the fossil *E. granulosus*, that neither the degree of convexity of shell, or abundance of spiniferous tubercles, or the arrangement of the pores (which are not in simple series), or the structure of the mouth or of the genital apparatus, can warrant the constitution of a generic group distinct from *Echinus*, using the word in its restricted sense, for the species in question.

*Description.*—The body varies in shape from sub-globular (as in fig. 2), to sub-conical (as in fig. 5), and to the unarmed eye resembles a miniature melon, studded over by minute uniform tubercles, and divided into five broad and five narrow segments, by narrow, depressed, punctured furrows, radiating above from a circle of apical plates, surrounding a central perforation, and converging below towards a much larger central circular orifice.

The ambulacral and interambulacral segments are composed of similar polygonal plates, very numerous. Those of the former are shortly oblong, those of the latter very narrow in vertical dimensions. All are covered by small, imperforate, thick-set primary tubercles, separated by minute secondary ones. The former alone were probably spiniferous, the latter probably indicate the position of the bases of pedicellariæ. The tubercles of both the ambulacral and interambulacral plates are

similar, but on the former the secondary granulations are more numerous than on the latter. On the ambulacral plates the primary tubercles are ranged in a single line, transverse to the form of the test, giving the surface a lineated aspect. In some specimens they fall so directly under each other, as to give the appearance of vertical as well as horizontal granulations. There are about eight or nine primary tubercles on a central interambulacral, and three on an ambulacral plate. The line of junction of the two series of interambulacrals, and sometimes of the ambulacrals in each segment, is not unfrequently strongly marked. In such specimens the interambulacrals occasionally exhibit a tendency to vertical carination. Opposite each plate are three pair of pores in the ambulacral sulci, which are very narrow, and run almost straightly down the sides. The number of pores are a multiple of the number of plates by three. The pores appear to form a single series, but are not really so arranged, as we may convince ourselves by tracing the poriferous avenues to their junction with the mouth. As they approach that orifice they exhibit a tendency to form oblique rows, and at length definitely fall into ranks of threes (fig. 11). Hence the distinction between the genus *Arbacia* (in the sense used by writers on fossils) and *Echinus*, founded on the arrangement of the pores in a single series in the former, and in many series in the latter, is a mistake. This is quite as plainly seen in the so-called *Arbacia monilis*, where the pairs of pores are ranked in fours so distinctly all over the shell that it is strange such an arrangement should have been overlooked. In an undescribed green-sand urchin, brought from Portugal by Mr. Daniel Sharpe, the general aspect of the shell, the arrangement of tubercles, &c., so closely resemble the species we are describing, that at first sight they seem identical, but when the poriferous avenues are examined, the pairs of pores are seen to fall into very oblique and unmistakable ranks of threes throughout. The mouth is circular, rather small in proportion to the base, and very slightly notched opposite the ambulacral furrows. The anal and ovarian circle is small in proportion, being about two-fifths of the breadth of the mouth. The diameter of the ovarian and anal circle is to the mouth as the maximum breadth of the ambulacral to that of the interambulacral segments. The anus was not protected by definite and symmetrical testaceous valves. The ovarian plates are subtriangular, and perforated in their centres by a conspicuous oviducal pore. One of them is in some specimens slightly larger than the rest, and exhibits traces of a madreporiform tubercle. The ocular plates are small, and angularly reniform; the perforation for the ocelli is in the central angle of their excavated and outer margins, thus presenting a slight abnormality of position. The ovarian circle is exactly the diameter of the widest and most central portion of



the ambulacral segments, as the mouth is of the interambulacral. I have not met with the spines. The shell is thin.

The largest example I have seen measured eight-twelfths of an inch in diameter. The proportion of elevation to breadth varies in almost every individual, and is quite as variable as it is well known to be in the recent *Echinus*. The specimen mentioned was five-twelfths of an inch in height, and had 34 plates in vertical succession, composing each half-segment, and consequently there were above 100 pairs of pores in each avenue, indicating as many suckers.

In four examples from the same locality the proportion of diameter to height was respectively as 17 to 10, 15 to 11, 12 to 11, and 12 to 8. The *Arbacia conica* of Agassiz, of which we have no other description than that it is near *granulosa*, "Mais plus haute et plus conique," cannot, therefore, be regarded as a species, or even as a marked variety. With the variations of proportion the shell becomes more or less globular.

*Locality and Geological Position.*—Very abundant in the upper green-sand of Warminster. (Survey Collection.) Chute Farm, Wilts.

On the Continent it was first noticed in the upper green-sand of Regensburg, in Bavaria. It occurs in France in the Craie chloritee of l'Isle d'Aix, Le Mans, and (*Arbac. conica*) Calvados.

The *Echinus pelos*, from the Neocomian of the canton of Neuchatel, is its nearest ally and predecessor.

M. Grateloup states that it is found at Dax, and in the white chalk of Pouillon.

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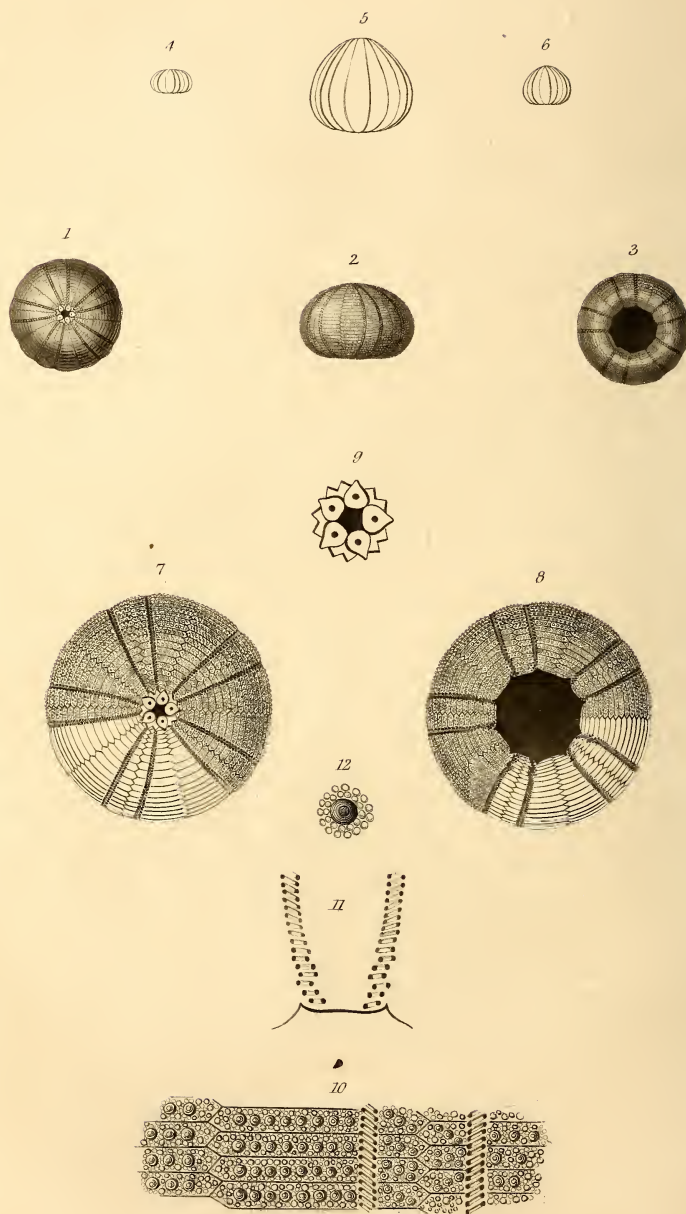
#### EXPLANATION OF THE PLATE.

Fig. 1. A specimen of ordinary dimensions, seen from above. Fig. 2. The same from the side; and Fig. 3, from below. Figs. 4, 5, and 6. Outlines of specimens of different ages, showing extreme variations of form. Fig. 5 appears to be the *Arbacia conica* of Agassiz. Figs. 7 and 8. Upper and under magnified views, showing the arrangement and articulations of the plates, which, for better display, are partly represented without their tubercles. Fig. 9. The circle of ovarian and ocular plates. Fig. 10. Ambulacral and interambulacral plates, with portions of avenues taken from the central portion of the side, showing the arrangements of the primary and secondary tubercles. Fig. 11. Portion of avenues near the mouth, showing that the apparent single arrangement of the pairs of pores is deceptive, and that they are really three-ranked. Fig. 12. One of the primary tubercles, seated on its elevated base, and surrounded by secondary granules.

E. FORBES.

April, 1849.

## Geological Survey of the United Kingdom.

ECHINUS  
(Cretaceous.)ECHINUS GRANULOSUS — *Munster*